#3

WHAT IS CLAIMED IS:

1. A three-dimensional visual inspection apparatus of semiconductor packages comprising:

a lighting means(16) that is located over the package element(18) to be inspected and lightens the element;

a prism(14) that is located over said lighting means(16) and splits the light from the package element(18) into two different optical paths;

a camera(12) that is located over said prism(14) and reads the stereo images obtained through said prism(14); and

an image processing system(10) that manipulates the stereo image signals read by said camera(12) and carries out three-dimensional visual inspection.

2. A three-dimensional visual inspection apparatus of semiconductor packages as claimed in claim 1, wherein said prism(14) is made of a transparent material, such as a glass or a crystal, and has a trigonal shape being able to get stereo images.

3. A three-dimensional visual inspection apparatus of semiconductor packages as claimed in claim 1,

wherein said lighting means(16) is an LED lighting.

4. A three-dimensional visual inspection apparatus of semiconductor packages as claimed in claim 1, wherein said lighting means(16) is a ring-type LED in case that said package element(18) is a BGA package.

5. A three-dimensional visual inspection method of semiconductor packages comprising the steps of:

performing a camera calibration(S100) to obtain the intrinsic parameters of a camera(12) and a prism(14) by using an object of which the exact three-dimensional information is known;

reading(S102) the stereo image that is obtained by inducing the light on a package element(18) and transmitting the light through said prism(14), which splits the light from said package element(18) into two different optical paths, and mapping a spatial point into two different points on an image plane(20) thereby;

extracting(S104) the characteristic points, which are corresponding to each other, from said two images;

calculating(S106) the disparity between two points;

extracting(S108) the distances to the corresponding

points and three-dimensional coordinates from the result of said calculating step(S106);

presuming(S110) a spatial plane using the three-dimensional information extracted through said extracting step(S108); and

performing(S112) a planarity inspection, which is a three-dimensional inspection, by analyzing the relative distribution of the characteristic points to said spatial plane.

6. A three-dimensional visual inspection method of semiconductor packages as claimed in claim 5,

wherein the characteristic points on the image in said extracting step(S104) are vertexes of spherical-shaped balls in case that said package is a BGA package.

7. A three-dimensional visual inspection method of semiconductor packages as claimed in claim 5,

wherein the characteristic points on the image in said extracting step(S104) are edges at the ends of the legs in case that said package is an SOP package.

8. A three-dimensional visual inspection method of semiconductor packages as claimed in claim 5,

wherein the three-dimensional distance in said extracting step(S108) is calculated by the following equation:

[Equation 3]

$$\frac{1}{d} = \frac{k_1}{Z_P} + k_2,$$

where,

$$k_1 = k_2 \bullet t_Z, \quad k_2 = \frac{1}{2 \bullet \alpha_u \bullet \tan\delta}, \quad \alpha_u = \frac{f}{c_x},$$

d : disparity calculated on the image, [pixel],

ZP : distance to the characteristic point, [mm],

k1, k2 : intrinsic parameters of the camera(12),

tZ : distance from the image plane(20) to the prism(14), [mm],

δ : internal angle of the prism(14), [radian],

f : focal length of the camera lens(22), [mm],

cx : length of an image sensor cell along with X-axis, [mm].

9. A three-dimensional visual inspection method of semiconductor packages as claimed in claim 5, wherein the planar equation in the presuming step(S110) is calculated by the following equation:

[Equation 4]

$$a \bullet x + b \bullet y + c \bullet z = d$$

where a, b, c, and d are coefficients of the planar equation extracted.